JSC-14005
Annex 1
SEP 1979

# Payload Data Package ANNEX

(NASA-TM-80819) PAYLOAD DATA PACKAGE-ANNEX: PAYLOAD ASSIST MODULE-DELTA CLASS (PAM-D) (NASA) 14 p

N80-70430

Unclas
00/16 39657

## Payload Assist Module - Delta Class (PAM-D)

September 1979

FOR INFORMATION ONLY
(these data have not been baselined)

National Aeronautics and
Space Administration

**Lyndon B. Johnson Space Center**
Houston, Texas

# PREFACE

This document contains the basic payload data on the Payload Assist Module-Delta Class (PAM-D) and is issued as an annex to the Payload Integration Plan for PAM-D (JSC-14005).

This annex is the single authoritative source for PAM-D payload data of the types designated herein. All data presented in this annex should be considered preliminary. Corrections and updates will be made as necessary with the next planned update publication being made as soon as all data are verified and approved by the Payload Manager and his staff.

Comments and corrections to these data as well as requests for additional data should be directed to E. Dixon Murrah, WC6, NASA-JSC, telephone 713-483-5927.

## 1.0 Weight and Mass Properties

The major weight elements and sub-elements of the SBS payload for the STS were established for this Annex based on the necessity for presenting sequenced mission mass properties in a logical order of events. The major and sub-elements used for mass properties presentation are as follows:

A. STS DEPLOYABLE PAYLOAD

A.B. EXPENDABLE PAM VEHICLE

B. PAM AIRBORNE SUPPORT EQUIPMENT

B.A. CRADLE

B.B. SPINTABLE

This report excludes all spacecraft and spacecraft airborne support equipment mass properties.

The propellant load for the PAM-D motor assumes a 2313 pound spacecraft will be used.

The STS Orbiter-related sequence of events analyzed and presented is as follows:

1. SBS/PAM-D mission mass properties at STS liftoff - sunshield open
2. SBS/PAM-D undeployed-sunshield closed
3. PAM-D ASE-vehicle deployed-sunshield closed
4. PAM-D ASE landing configuration-vehicle deployed - sunshield open

### 1.1 Mass Properties Coordinate System

The PAM-D mass properties coordinate system is shown in Figure 1. The subscript "KF" is used to identify this system. The letters "KF" are also used as a coordinate code and are displayed on the computer printouts. Note that the $Y_{KF}$ $Z_{KF}$ plane and the $X_{KF}$ $Z_{KF}$ plane pass through the center of the keel trunnion. The $Z_{KF}$ origin is the same as the Orbiter Z-axis origin.

### 1.1.2 Percentage Weight Classification

The weight classifications for the PAM-D are identified as estimated, calculated, and actual. The following table defines the weight and percent weight class for the PAM-D sub-elements.

| Element | PIP Control Weight (Pounds) | Total Weight (Pounds) | Percent of Total Weight Est | Calc | Act |
|---|---|---|---|---|---|
| EXPENDABLE PAM VEHICLE | 4918* | 4,217 | 10 | 90 | 0 |
| SPINTABLE | } 2244* | 293 | 10 | 90 | 0 |
| CRADLE | | 1,953 | 15 | 85 | 0 |
| TOTAL | 7162 | 6463 | | | |

1.2 Sequenced Mass Properties

The STS-related mission mass properties are given in Tables 1 , 2, 3, and 4. The Mass Properties at STS Liftoff can also be used for abort mission landing mode.

1.3 Potential Mass Properties Changes

There are no significant potential mass properties changes identified at this time.

*BASED ON AN SBS TYPE SPACECRAFT AND DOES INCLUDE THE 11 POUNDS OF CROSSOVER ELECTRICAL HARNESS. WHICH IS CHARGED TO THE PAM-D.

## 2.0 RF RADIATION DATA

Two minutes prior to deployment, the PAM-D S-Band transmitter will be activated. After deployment, the RF link will be established with the orbiter payload interrogator.

### 2.1 PAM-D Transmitting System

Transmitter System Name -- PAM Telemetry Transmitter
Type -- Phase Modulated
Center Frequency -- 2237.5 MHz
Deviation -- ± 1 Radian
Modulation Frequency -- 1.024 MHz Subcarrier
Output -- 8.5 watts min, 14 watts max.
Number of Antennas -- One
Cable Loss, Transmitter to Antenna -- 1.0 dB

### 2.2 PAM-D Receiving System - N/A

### 2.3 PAM-D Antenna System

Antenna System Name -- PAM Telemetry Antenna
Antenna Location -- Fifty-five inch diameter belt around PAM-D motor axis, located 24 inches aft of S/C separation plane.
Associated Antennas -- None
Antenna Gain on Boresight -- -11 dbic -- essentially omni-directional distribution
Antenna Field Polarization -- Linear
Antenna Effective Diameter -- not applicable to omni-antennas
Antenna Pointing from the Radial in Degrees of Elevation and Azimuth -- TBD
Antenna Efficiency -- TBD
Antenna Radiation Distribution Plot -- TBD (Coverage is nominally in the solid angle from 45 to 150 degrees measured from the spacecraft fwd spin axis.)
Transmitter Turn-On -- Two minutes prior to deployment until end of PAM-D mission (battery depletion).

## 3.0 PAYLOAD PHYSICAL FUNCTION DATA

The SBS utilizes a SSUS-D, which includes a solid rocket motor, to provide the necessary perigee impulse to place the spacecraft into its transfer orbit from the low altitude parking orbit of the Orbiter (160 miles with a 28.5 degree inclination). The SSUS-D is spin stabilized during perigee injection; the spin-up being done while SSUS-D is still attached to and pointed by the Orbiter.

### 3.1 Payload Deployment and Retrieval System (PDRS) Translation Requirement - N.A.

### 3.2 Spun-Up Payload

Type of spin mechanism-Redundant electric motors

Location of spin mechanism and where torque will be applied to payload-Aft end of SSUS-D (SEE FIGURE TBD)

Expected torque to be applied-Less than 1 radian/sec$^2$ to the 3712 attach fitting at base of spacecraft

Duration of torque-52-67 seconds

Spin velocity - 50 to 65 rpm $\pm$ 10%

Spin duration - minutes (approximately)

Orientation of axis about which the torque is applied:

parallel to Z axis

TORQUE TIME HISTORY (TBD)

### 3.3 SEPARATION MECHANISM (TBD)

R03929 M123 PROGRAM REPORT

DETAIL MOMENT OF INERTIA

| SORT | LEVEL | TITLE | MASS (LBS.) | X (IN.) IXX IYZ (LB-IN2) | Y (IN.) IYY IXZ (LB-IN2) | Z (IN.) IZZ IXY (LB-IN2) |
|---|---|---|---|---|---|---|
| 1 | 2345 | | | | | |
| A | - | | | | | |
| A | B | EXPENDABLE PAM VEHICLE | 4,216.876 | 35.400<br>+.1240308E+07<br>+.2740294E+01 | 0.000<br>+.1232029E+07<br>-.1578051E+01 | 360.187<br>+.1227221E+07<br>+.1584229E+04 |
| A | | STS DEPLOYABLE PAYLOAD | 4,216.876 | 35.400<br>+.1240308E+07<br>+.2740294E+01 | 0.000<br>+.1232029E+07<br>-.1570401E+01 | 360.187<br>+.1227221E+07<br>+.1584229E+04 |
| B | - | | | | | |
| B | A | CRADLE | 1,952.913 | 32.577<br>+.8894866E+07<br>+.6766089E+06 | 10.942<br>+.4045464E+07<br>-.2822009E+05 | 374.442<br>+.8243278E+07<br>-.1593758E+06 |
| B | B | SPINTABLE | 292.676 | 37.471<br>+.8042962E+05<br>+.1671481E+01 | -0.042<br>+.1011991E+06<br>-.9663662E+03 | 328.699<br>+.1499046E+06<br>+.4659453E+04 |
| B | | PAM AIRBORNE SUPT EQUIP | 2,245.589 | 33.215<br>+.9538578E+07<br>+.8044916E+06 | 9.510<br>+.4685335E+07<br>-.8617431E+05 | 368.480<br>+.8429986E+07<br>-.1684001E+06 |

5

PRINCIPAL MASS PROPERTIES DATA

GRAND TOTAL

| MASS (LBS.) | X (IN.) | Y (IN.) | Z (IN.) | IXX IYZ (SLUG-FT2) | IYY IXZ (SLUG-FT2) | IZZ IXY (SLUG-FT2) |
|---|---|---|---|---|---|---|
| 6,462.465 | 34.641 | 3.305 | 363.069 | +.2376870E+04<br>+.1985846E+03 | +.1300467E+04<br>-.2433216E+02 | +.2114527E+04<br>-.4257862E+02 |
| | | | | (LB-IN2) | (LB-IN2) | (LB-IN2) |
| | | | | +.1101217E+08<br>+.9200536E+06 | +.6025137E+07<br>-.1127323E+06 | +.9796723E+07<br>-.1972691E+06 |

| AXIS | PRINCIPAL MOI (SLUG-FT2) | PRINCIPAL ANGLES (DEG) FROM +X | FROM +Y | FROM +Z | DIRECTION COSINES COS (X) | COS (Y) | COS (Z) |
|---|---|---|---|---|---|---|---|
| 1 | +.2379740E+04 | 4.39 | 88.50 | 85.87 | .997068 | .026100 | .071934 |
| 2 | +.1252645E+04 | 92.39 | 13.25 | 76.97 | -.041744 | .973360 | .225449 |
| 3 | +.2159479E+04 | 93.68 | 103.17 | 13.69 | -.064133 | -.227790 | .971596 |

DATA IS PRESENTED IN THE (KF) PAM-D KEEL FITTING COORDINATE SYSTEM

SBS/PAM-D MISSION MASS PROPERTIES AT STS LIFTOFF - SUNSHIELD OPEN DATE 04/09/79

Table 1

R03929 W123 PROGRAM REPORT

DETAIL MOMENT OF INERTIA

| SORT LEVEL | TITLE | MASS (LBS.) | X (IN.) IXX IYZ (LB-IN2) | Y (IN.) IYY IXZ (LB-IN2) | Z (IN.) IZZ IXY (LB-IN2) |
|---|---|---|---|---|---|
| 1 2345 | | | | | |
| A - | | | | | |
| A B | EXPENDABLE PAM VEHICLE | 4,216.876 | 35.400<br>+.1240308E+07<br>+.2740294E+01 | 0.000<br>+.1232029E+07<br>-.1578051E+01 | 360.187<br>+.1227221E+07<br>+.1584229E+04 |
| A | STS DEPLOYABLE PAYLOAD | 4,216.876 | 35.400<br>+.1240308E+07<br>+.2740294E+01 | 0.000<br>+.1232029E+07<br>-.1570401E+01 | 360.187<br>+.1227221E+07<br>+.1584229E+04 |
| B - | | | | | |
| B A | CRADLE | 1,952.913 | 32.637<br>+.8982655E+07<br>+.6639599E+06 | 10.942<br>+.4224138E+07<br>-.1845594E+05 | 375.034<br>+.8140114E+07<br>-.1658613E+06 |
| B B | SPINTABLE | 292.676 | 37.471<br>+.8042962E+05<br>+.1671481E+01 | -0.042<br>+.1011991E+06<br>-.9663662E+03 | 328.699<br>+.1499046E+06<br>+.4659453E+04 |
| B | PAM AIRBORNE SUPT EQUIP | 2,245.589 | 33.267<br>+.9640240E+07<br>+.7934975E+06 | 9.510<br>+.4077734E+07<br>-.7643343E+05 | 360.995<br>+.8334673E+07<br>-.1747164E+06 |

## PRINCIPAL MASS PROPERTIES DATA

GRAND TOTAL

| MASS (LBS.) | X (IN.) | Y (IN.) | Z (IN.) | IXX IYZ (SLUG-FT2) | IYY IXZ (SLUG-FT2) | IZZ IXY (SLUG-FT2) |
|---|---|---|---|---|---|---|
| 6,462.465 | 34.659 | 3.305 | 363.248 | +.2401598E+04<br>+.1977600E+03 | +.1344707E+04<br>-.2243882E+02 | +.2093883E+04<br>-.4378353E+02 |
| | | | | (LB-IN2)<br>+.1112673E+08<br>+.9162332E+06 | (LB-IN2)<br>+.6230102E+07<br>-.1039603E+06 | (LB-IN2)<br>+.9701076E+07<br>-.2028515E+06 |

| AXIS | PRINCIPAL MOI (SLUG-FT2) | PRINCIPAL ANGLES (DEG) FROM +X | FROM +Y | FROM +Z | DIRECTION COSINES COS (X) | COS (Y) | COS (Z) |
|---|---|---|---|---|---|---|---|
| 1 | +.2404151E+04 | 3.49 | 88.19 | 87.01 | .998145 | .031527 | .052092 |
| 2 | +.1293637E+04 | 92.48 | 14.16 | 76.06 | -.043194 | .969607 | .240825 |
| 3 | +.2142397E+04 | 92.46 | 104.04 | 14.26 | -.042916 | -.242628 | .969170 |

DATA IS PRESENTED IN THE (KF) PAM-D KEEL FITTING COORDINATE SYSTEM

SBS/PAM-D UNDEPLOYED-SUNSHIELD CLOSED

DATE 04/09/79

Table 2

R03929 W123 PROGRAM REPORT

DETAIL MOMENT OF INERTIA

| SORT LEVEL | TITLE | MASS (LBS.) | X (IN.) IXX IYZ (LB-IN2) | Y (IN.) IYY IXZ (LB-IN2) | Z (IN.) IZZ IXY (LB-IN2) |
|---|---|---|---|---|---|
| 1 2345 | | | | | |
| A - | | | | | |
| A | STS DEPLOYABLE PAYLOAD | .000 | 0.000<br>-.5528094E-07<br>+.0000000E+07 | 0.000<br>-.5531038E-07<br>+.0000000E+07 | 0.000<br>-.2944035E-10<br>+.0000000E+07 |
| B - | | | | | |
| B A | CRADLE | 1,952.913 | 32.637<br>+.8982655E+07<br>+.6639599E+06 | 10.942<br>+.4224138E+07<br>-.1845594E+05 | 375.034<br>+.8148114E+07<br>-.1658613E+06 |
| B B | SPINTABLE | 292.676 | 37.471<br>+.8042962E+05<br>+.1671481E+01 | -0.042<br>+.1011991E+06<br>-.9663662E+03 | 328.699<br>+.1499046E+06<br>+.4659453E+04 |
| B | PAM AIRBORNE SUPT EQUIP | 2,245.589 | 33.267<br>+.9640240E+07<br>+.7934975E+06 | 9.510<br>+.4877734E+07<br>-.7643343E+05 | 368.995<br>+.8334673E+07<br>-.1747164E+06 |

PRINCIPAL MASS PROPERTIES DATA

GRAND TOTAL

| MASS (LBS.) | X (IN.) | Y (IN.) | Z (IN.) | IXX IYZ (SLUG-FT2) | IYY IXZ (SLUG-FT2) | IZZ IXY (SLUG-FT2) |
|---|---|---|---|---|---|---|
| 2,245.589 | 33.267 | 9.510 | 368.995 | +.2080752E+04<br>+.1712687E+03 | +.1052811E+04<br>-.1649740E+02 | +.1798958E+04<br>-.3771084E+02 |
| | | | | (LB-IN2) | (LB-IN2) | (LB-IN2) |
| | | | | +.9640240E+07 | +.4877734E+07 | +.8334673E+07 |
| | | | | +.7934975E+06 | -.7643343E+05 | -.1747164E+06 |

| AXIS | PRINCIPAL MOI (SLUG-FT2) | PRINCIPAL ANGLES (DEG) FROM +X | FROM +Y | FROM +Z | DIRECTION COSINES COS (X) | COS (Y) | COS (Z) |
|---|---|---|---|---|---|---|---|
| 1 | +.2082542E+04 | 2.86 | 88.29 | 87.71 | .998750 | .029918 | .040033 |
| 2 | +.1013849E+04 | 92.17 | 12.54 | 77.66 | -.037808 | .976159 | .213740 |
| 3 | +.1836128E+04 | 91.87 | 102.41 | 12.56 | -.032684 | -.214987 | .976071 |

DATA IS PRESENTED IN THE (KF) PAM-D KEEL FITTING COORDINATE SYSTEM

PAM-D ASE-VEHICLE DEPLOYED-SUNSHIELD CLOSED

DATE 04/09/79

Table 3

RQ3929 W123 PROGRAM REPORT

DETAIL MOMENT OF INERTIA

| SORT LEVEL | TITLE | MASS (LBS.) | X (IN.) / IXX / IYZ (LB-IN2) | Y (IN.) / IYY / IXZ (LB-IN2) | Z (IN.) / IZZ / IXY (LB-IN2) |
|---|---|---|---|---|---|
| 1 2345 | | | | | |
| A - | | | | | |
| A | STS DEPLOYABLE PAYLOAD | .000 | 0.000<br>-.5528094E-07<br>+.0000000E+07 | 0.000<br>-.5531038E-07<br>+.0000000E+07 | 0.000<br>-.2944035E-10<br>+.0000000E+07 |
| B - | | | | | |
| B A | CRADLE | 1,952.913 | 32.577<br>+.8894866E+07<br>+.6766089E+06 | 10.942<br>+.4045464E+07<br>-.2822009E+05 | 374.442<br>+.8243278E+07<br>-.1593758E+06 |
| B B | SPINTABLE | 292.676 | 37.471<br>+.8042962E+05<br>+.1671481E+01 | -0.042<br>+.1011991E+06<br>-.9663662E+03 | 328.699<br>+.1499046E+06<br>+.4659453E+04 |
| B | PAM AIRBORNE SUPT EQUIP | 2,245.589 | 33.215<br>+.9538578E+07<br>+.8044916E+06 | 9.510<br>+.4685335E+07<br>-.8617431E+05 | 368.480<br>+.8429986E+07<br>-.1684001E+06 |

8

PRINCIPAL MASS PROPERTIES DATA

GRAND TOTAL

| MASS (LBS.) | X (IN.) | Y (IN.) | Z (IN.) | IXX / IYZ (SLUG-FT2) | IYY / IXZ (SLUG-FT2) | IZZ / IXY (SLUG-FT2) |
|---|---|---|---|---|---|---|
| 2,245.589 | 33.215 | 9.510 | 368.480 | +.2058809E+04<br>+.1736416E+03 | +.1011283E+04<br>-.1859986E+02 | +.1819530E+04<br>-.3634753E+02 |
| | | | | (LB-IN2) | (LB-IN2) | (LB-IN2) |
| | | | | +.9538578E+07<br>+.8044916E+06 | +.4685335E+07<br>-.8617425E+05 | +.8429986E+07<br>-.1684001E+06 |

| AXIS | PRINCIPAL MOI (SLUG-FT2) | PRINCIPAL ANGLES (DEG) FROM +X | FROM +Y | FROM +Z | DIRECTION COSINES COS (X) | COS (Y) | COS (Z) |
|---|---|---|---|---|---|---|---|
| 1 | +.2060813E+04 | 3.67 | 88.58 | 86.61 | .997945 | .024784 | .059093 |
| 2 | +.9741306E+03 | 92.08 | 11.83 | 78.36 | -.036259 | .978750 | .201829 |
| 3 | +.1854679E+04 | 93.03 | 101.74 | 12.14 | -.052835 | -.203557 | .977637 |

DATA IS PRESENTED IN THE (KF) PAM-D KEEL FITTING COORDINATE SYSTEM

PAM-D ASE-LANDING CONFIGURATION-VEHICLE DEPLOYED - SUNSHIELD OPEN DATE 04/09/79

Table 4

# PAM-D KEEL FITTING COORDINATE SYSTEM
# COORDINATE CODE = "KF"

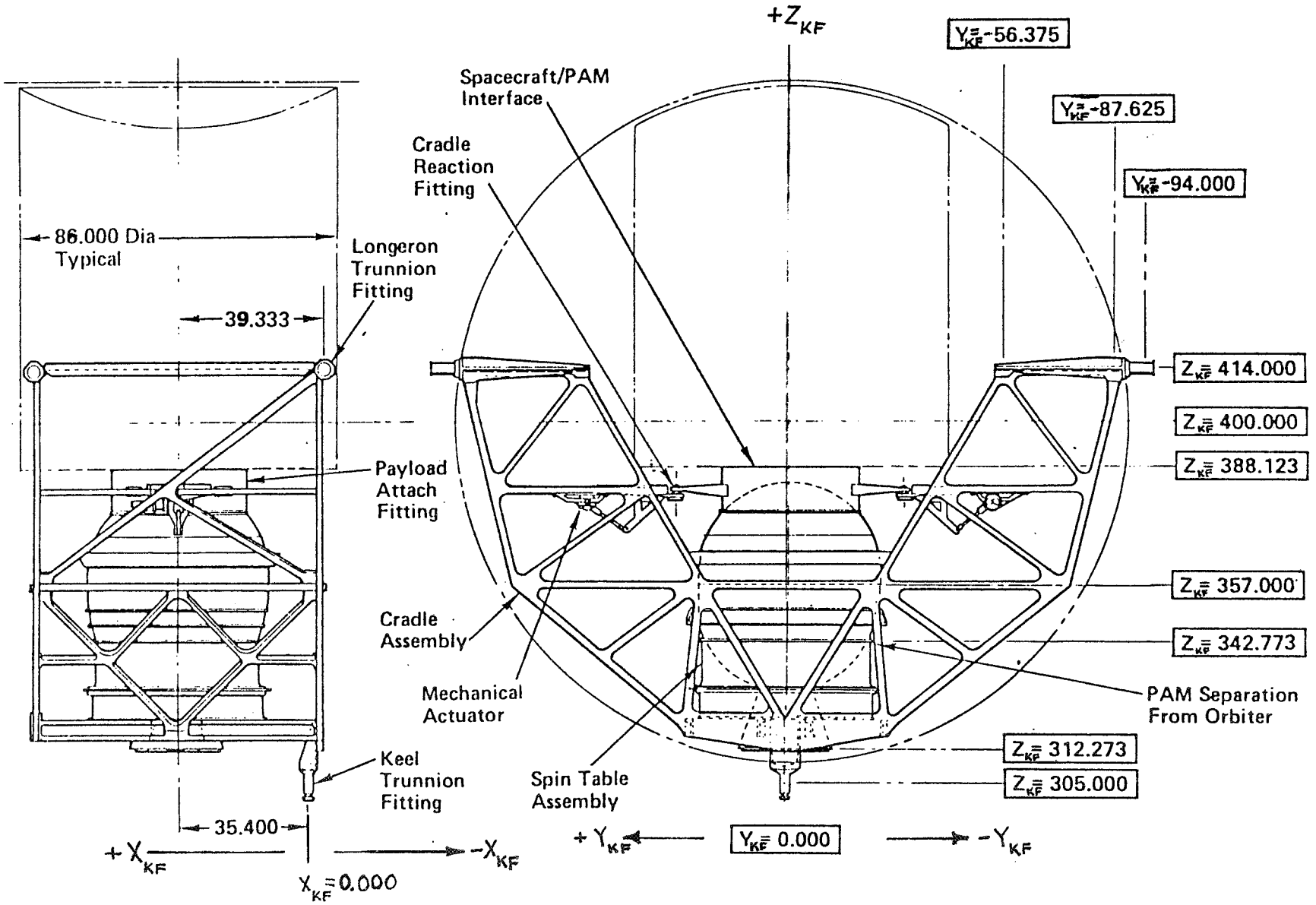
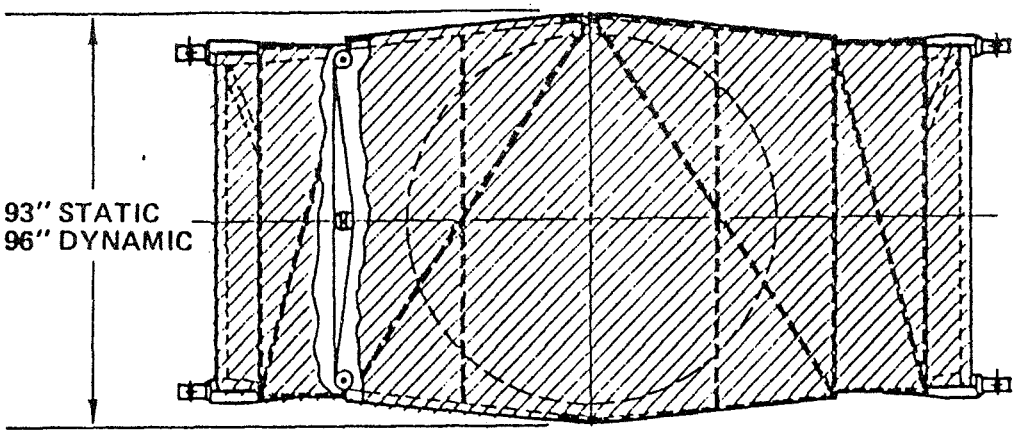



FIGURE 1

# PAM-D THERMAL CONTROL SYSTEM



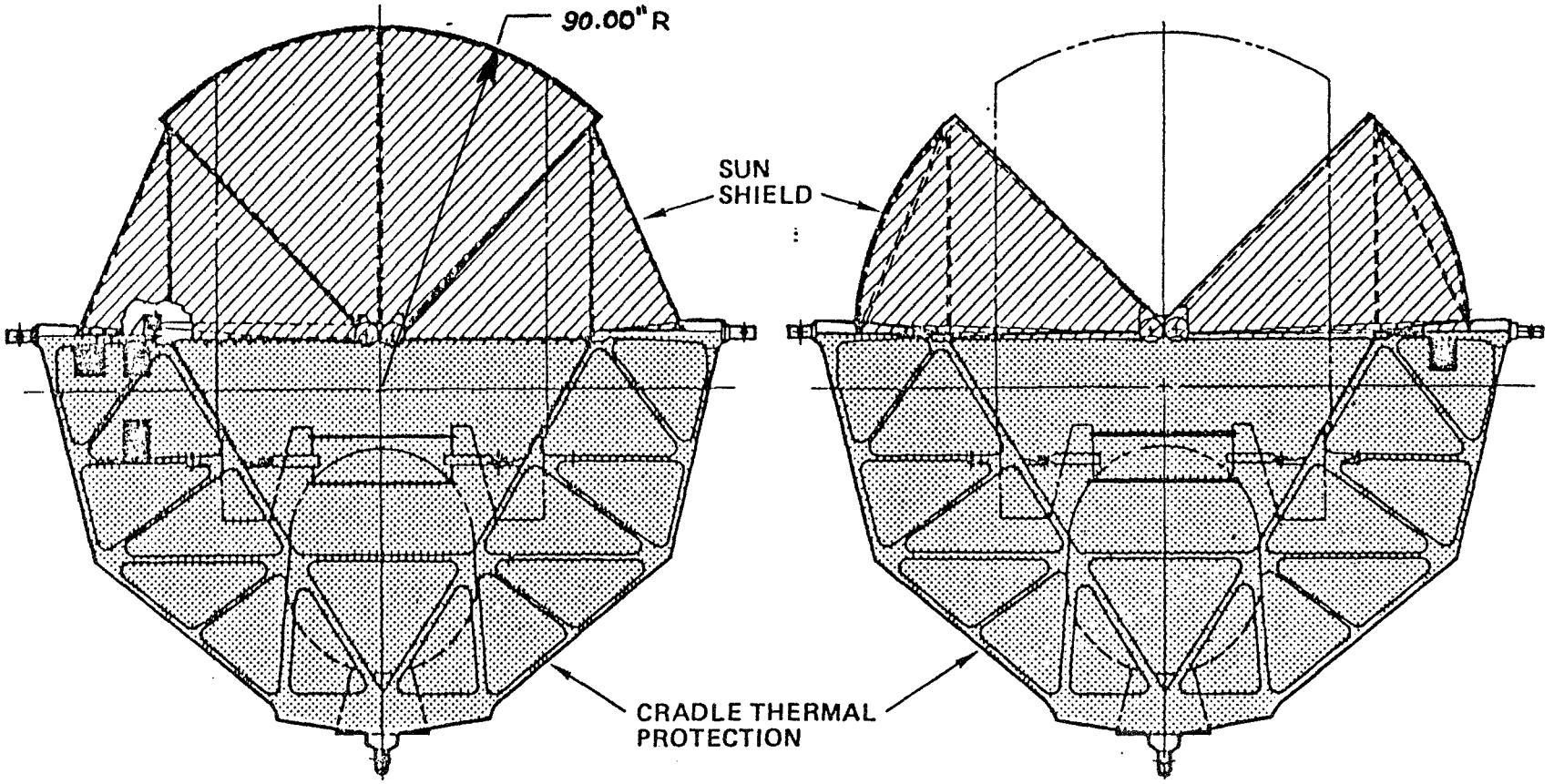




FIGURE 2

Figure 3.- PAM-D Sunshield
Sunshield to Spacecraft Clearances (Static).

NOTE: This figure contains McDonnell Douglas Astronautics Company Proprietary Information. The data contained in the figure has been printed and placed under a separate cover in order to control and protect these data from unauthorized use or disclosure. The figure will be released to distribution on a need-to-know basis. Requests for this figure as well as requests for additional copies of the figure should be directed to E. Dixon Murrah, WC6, NASA-JSC, telephone 713-483-5927.

Figure 4.- PAM-D/Orbiter Interface Drawing (Dwg. No. 1D23509, Sht. 1).

NOTE: This drawing contains McDonnell Douglas Astronautics Company Proprietary Information. The data contained in the drawing has been printed and placed under a separate cover in order to control and protect these data from unauthorized use or disclosure. The figure will be released to distribution on a need-to-know basis. Requests for this figure as well as requests for additional copies of the figure should be directed to E. Dixon Murrah, WC6, NASA-JSC, telephone 713-483-5927.

DISTRIBUTION LIST FOR PAYLOAD INTEGRATION PLAN
JSC-14005 COMPLETED ANNEX NO. 1

STANDARD DISTRIBUTION

NASA JSC
BT/W. Draper
CA/J. F. Honeycutt
CA7/N. T. Buras
CB/Payloads
CF4/W. P. Gatlin
CG3/D. L. Dahms
CG5/T. A. Guillory
CG5/B. Ferguson
CG5/J. A. Wegener
CH/C. S. Harlan
CH6/B. L. Kyle
EA3/R. S. Sayers
EA8/L. E. Bell
EC/D. W. Morris
EE4/W. E. Perry
EH13/C. D. Levy
EH2/T. W. Eggleston
ES/D. H. Greenshields
ES/D. C. Wade
ES12/R. J. Wren
ES2/B. W. Holder
ES3/R. G. Brown
ES5/M. W. Steinthal
EW/W. W. Petynia
EW52/C. D. Perner
FA/S. D. Sanborn
FM4/H. B. Beck
FM2/E. C. Lineberry
FE/S. Faber
FR/J. Broadfoot
FS5/J. L. Parker
FS15/E. Clayton
FS15/T. A. Stuart
JM61/F. D. Goodson (5)
JM86/Remainder
LM/A. Bishop
LT/R. Kohrs
NS2/B. J. Miller
PA/G. S. Lunney
PF/L. S. Nicholson
PF/H. M. Scott
PH/L. G. Williams
PL/C. B. Peterson
SC3/S. Hardee
WC/M. A. Collins
WC/CMO (3)
WC2/D. H. Cordiner
WC6/E. D. Murrah (20)
WT/R. A. Colonna
WT3/Z. K. Eubanks

Nasa Headquarters
MO-6/C. M. Lee
MOB-6/W. O. Armstrong

KSC
CP-PCO/J. C. McBrearty
CS-OMO/R. E. Reyes
NWSI-D (5)
Rockwell - Houston
ZCO1/Don Hass

Rockwell - Downey
BA04/Data Management (25)

TRW - Houston
O. Bergman

UNIQUE DISTRIBUTION

PF/Project Engineer
V. Ettridge

WC/Integration Engineer
C. Walsh

Systems Engineer
PH/D. Hudson

Payload Officer
CH6

Launch Site Support Manager/KSC

Payload Supplier

Others

For additions, deletions, or corrections to this distribution list, please notify WC2/L. M. Brubaker or WC2/M. F. Crocker, NASA-JSC, telephone no. 713-483-5565.